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# IOT Based Home Automation System Using Raspberry Pi with Web Server

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**ABSTRACT:** This documentation presents a cloud-based home automation system implemented using the Raspberry pi. This is a proof of concept for a home (industry) that can be monitored and controlled remotely from anywhere in the world via the Internet. A “connected” home like this can make life more convenient and also safer. The remote monitoring aspect of this project demonstrates the ability of being able to know what is going on with different systems at home which can be used for control and safety. For example, we can monitor the temperature for ambient control, the state of some sensors for intruder detection and the state of different devices like fans or lights at home. It is also demonstrated using a few motors, how one can control different systems at home using the cloud service via the Internet. So, a virtual “switch” available in the cloud UI can be toggled to turn on/off a fan or open/close a garage door at home. This project has a very large scope and can be integrated with many other systems like smart electronic appliances at home. This documentation describes the project implementing the basic framework to achieve such a connected home. It gives a summary of hardware and software in the current implementation of the project, future improvements and scope.

**KEYWORDS:** Home Automation, Smart Home, Automation, IOT, Webservice, Raspberry Pi Projects.

### I. INTRODUCTION

The cloud-based home automation project is inspired by the necessity to monitor and control the home remotely in an affordable way. Today, technology innovations are being focused more than ever on the Internet of Things (IoT). A world where everything is smart and connected is already work in progress. The Sky Link Home Smart Centre AM-100A and advanced home controllers like the ISY994i that operate only with INSTEON devices are few of the available solutions today. The majority of these require compatible appliances to be purchased posing a serious limitation to adapting these solutions. This project was inspired by the fact that integrated home automation systems today are expensive in terms of installation and regular maintenance. Some of them are difficult to operate due to the required interface learning during setup. The presented prototype aims to use as few resources as possible to demonstrate a simple and low cost connected home. It consists of a base node connected to a cloud service (hosted externally) where we can check the status of different appliances and sensors at home.

This system can be used for controlling the indoor & outdoor lights, heat, ventilation, air conditioning in the house, to lock or open the doors & gates, to control electrical & electronic appliances and so on using various control systems with appropriate sensors.

We can Set Schedule timings hence no power loss. (through programming). Guard your home, you can create an alarm that will alert you if there's movement in your house. You can also Broadcast a Live Stream of your Home to help you keep an eye on it while you're away.

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## II. LITERATURE SURVEY

In the existing system, the studies on Home Automation System focuses on addressing the problems or power consumption range of operation and cost of the whole system. To automate the appliances, various methods are used like SMS and Email. The work presented here is focused on fast and easily accessible of a wireless smart home automation system to reduce the manual work and everyone accesses this system. It is having low cost, secure, and access fast as compared to the previous systems.

Piyare&Tazil [1] et al. proposed the work on this by using the Bluetooth technology for Home Automation System using an Arduino board as well as the wireless system. Through a Bluetooth connection, a cell phone or mobile device is used to send commands to the Bluetooth antenna of the Arduino board but the disadvantage in this is that it is applicable only for the short distance.

D. Pavithra et al. [2] proposed a work on IoT based Monitoring and Control System for Home Automation and it used the portable devices for the user interface. They can communicate with Internet gateway, by using low power communication protocols like ZigBee, WI-Fi, etc. It makes web portal to interact with the devices at home and web portal is accessed via Smartphone. It doesn't provide security to their system and limited no. of devices are used in their work.

B. Pandya et al. [3] proposed a work on Android Based Home Automation System using Bluetooth & voice command. It used an Arduino microcontroller for connecting the appliances, a Bluetooth module for transferring the signal which is running on Smartphone an Android application. The limitation of this work is that it uses a microcontroller which converts the byte signal into string format so there must be a delay in the system.

Rajeev Piyare and Seong Ro Lee [4] present a low cost and flexible home control as well as monitoring system. In this system an embedded micro-web server is used for accessing and controlling devices and appliances remotely, using Android based Smart phone app. The proposed system architecture is divided into three layers: home environment, home gateway and remote environment. The proposed home automation system two types of software; one for server application (it is a library implementation of a micro Web-server running on Arduino Uno using the Ethernet shield to communicate between remote user and the Home Gateway) and other is for microcontroller firmware.

## III. PROPOSED SYSTEM

As the system uses Raspberry Pi, Relay circuit, Pi camera are the main part of the project here the Raspberry Pi acts as a web server and as well as microcontroller for programming. As per the Programming done in the Microcontroller, the Web page is displayed on the screen in which the buttons are viewed as On/Off. When clicked on buttons (On), this feedback is given to the microcontroller. There are 10 GPIO pins which are defined in the microcontroller i.e. pin 5, pin 6, pin 13, pin 19 are connected which are given to the 4 relays as shown in the setup figure 2, pins 17 & 23 for servo motors to control pan and tilt movements, pins 27 & 22 for ultrasonic sensor, pins 20 & 21 for PIR sensor and Buzzer respectively. Through HTML & PHP language when the button is pressed, the data is passed into the server. When clicked on button, their respective pin goes high and operates relay. Relay will operate, bulb will glow on and the device will operate and same process will continue same for pins 5,6,13&19.

The proposed system consists of Raspberry Pi, Pi camera, Relay module, PIR sensor, Ultrasonic Sensor, Servo motors, Web server.

**Raspberry Pi:** The Raspberry Pi is a credit card sized, single board computer developed in the UK by the Raspberry Pi Foundation. The Raspberry Pi has a Broadcom BCM2835 System on a Chip (SoC), which includes an ARM1176JZF-S 700 MHz processor. It has an internal storage of 512 MB, external storage supported up to 32 GB, 1 Ethernet port, 4-2.0 USB ports, 1 micro SD card slot, DSI display connector, 1 HDMI out port, 1 CSI Camera connector, 5V USB power, RCA. The Raspberry Pi2 B model CPU is of ARM 11 family operates at 700MHz. The GPU having Broadcom Video core-IV, open GLES 2.0, 1080p30, H.264/MPEG-4, AVC high profile decoder and capable of 1Gpixel/s, 1.5 G Texel/s (or) 40 GFLOPs of general-purpose (GPIO) compute. It operates 2A at 5V power supply. With the help of GPIO pins we can control the devices from any place

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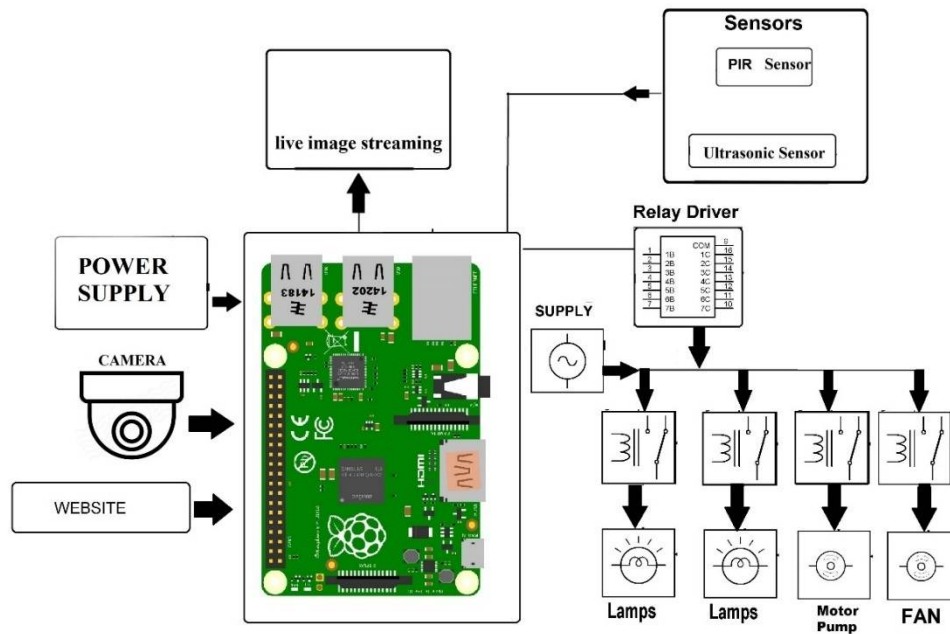


Fig1: Block Diagram of Proposed system

**Pi Camera:**The Raspberry Pi Camera module is connected to CSI port of raspberry pi. This is an 8 Megapixel night vision camera used to broadcast a live stream to webpage through raspberry pi, thus, we can watch live stream of our home from anywhere in the world. This camera is attached to servo motors to rotate (right, left, up and down) the camera.

**Relay Module:**A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal.

**Ultrasonic Sensor:** An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonar sensor and the object.

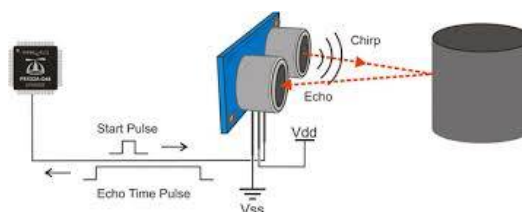


Fig.2: Ultrasonic sensor basic Concept

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Since it is known that sound travels through air at about 344 m/s (1129 ft/s), you can take the time for the sound wave to return and multiply it by 344 meters (or 1129 feet) to find the total roundtrip distance of the sound wave. Roundtrip means that the sound wave traveled 2 times the distance to the object before it was detected by the sensor; it includes the 'trip' from the sonar sensor to the object and the 'trip' from the object to the Ultrasonic sensor (after the sound wave bounced off the object). To find the distance to the object, simply divide the roundtrip distance in half.

The Ultrasonic sensor is used to find the water level in the water tank. By calculating the distance of water level from the top we can control the motor by using microcontroller.

**PIR Sensor:** A PIR (Passive InfraRed) sensor is a motion detector which detects the heat (infrared) emitted naturally by humans and animals. When a person in the field of vision of the sensor moves, the sensor detects a sudden change in infrared energy and the sensor is triggered (activated). They are commonly used in security lighting and alarm systems in an indoor environment. The PIR sensors have a range of approximately 6 meters, depending on conditions. The sensor adjusts to slowly changing conditions that occur normally within the environment but shows a high output response when a sudden change takes place.

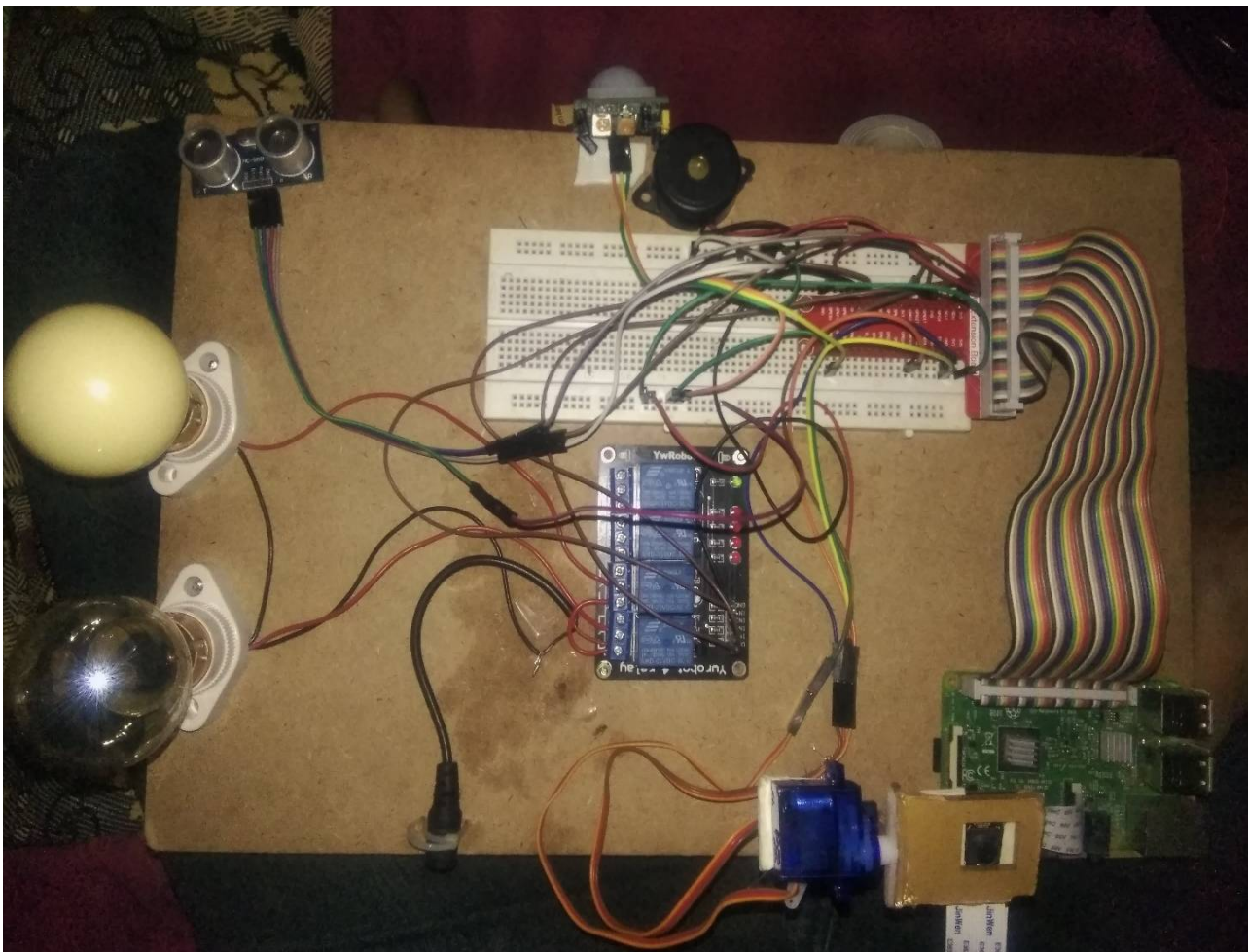


Fig.3: Experimental setup

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**Web Server:** Web server is a program that uses HTTP to serve files that create web pages to users in response to their requests, which are forwarded by their computers HTTP connection. Any server that delivers an XML document to another device can be a Web server. A better definition might be that a Web server is an Internet server that responds to HTTP requests to deliver content and services.



Fig.4: Example for Web Server

For an example, I can say if you are in front of your computer, browsing your Web, and you get a message from a friend saying, "I had just read a great article! You can check it from the following URL. It'sat<http://www.fastwebhost.in/blog>"So you will type that URL into your browser and press enter.

And that's it, no matter where the website hosted in the world, the page will be displayed on your computer screen. Always a web server is connected to the internet. Every Web server that connects to the Internet will be provided with a unique address which was arranged with a series of four numbers between 0 and 255 separated by periods. Also, web server enables the hosting providers to manage multiple domains(users) on a single server. A web host is a company that leases out space on a cluster of servers to empower people to serve their own content & webpages.

#### IV. EXPERIMENTAL RESULTS

The Raspberry Pi is programmed using HTML which is passed using 'PHP' 'Java script' language. Here a webpage has been created to continuously monitor the home appliances through Internet that will be displayed to the user wherein the user has to establish connection with mobile or PC remotely accessing appliances. Figure 5 shows the browser page which we designed using HTML language as a home page, Once the home page is loaded, the user need to enter IP address (192.168.0.101) to facilitate the further access to control home appliances

In the proposed system two devices are considered for demo purpose bulb1, bulb2, on this page we can control 2 devices just by clicking the menus on the web page, initially all devices will be in off State i.e. '0' state. The user can access this system using PC/Mobile. Using this GUI, user interacts with the system to control devices. when '0' state means the device will OFF when '1' state means device will be 'ON'. So, in this way we can turn on and off the appliances present in our homes. If passive infrared sensor (PIR sensor) sense movement of people, animals, or other objects it rises an alarm and send the status to web page.

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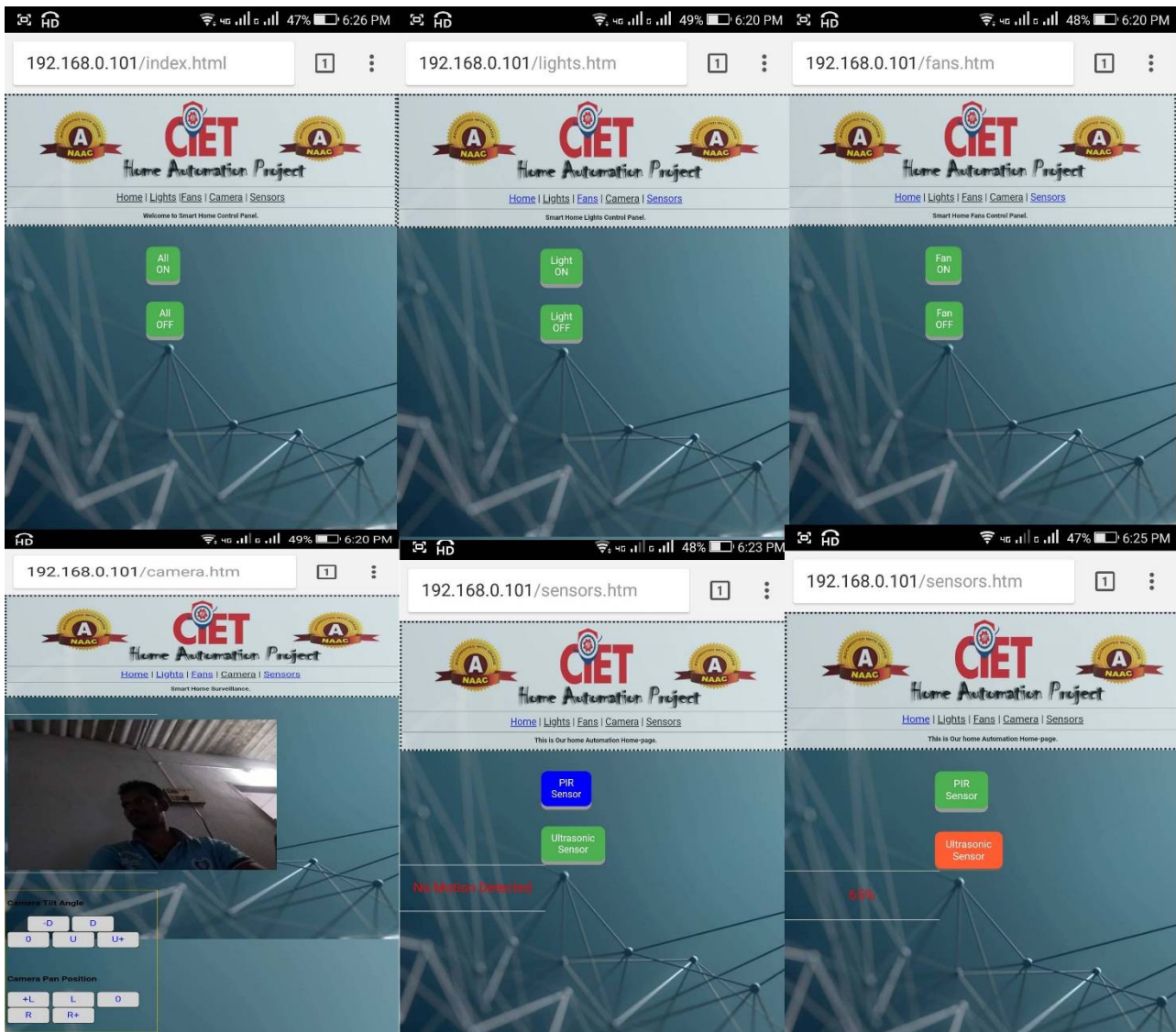


Fig.5 Screen shots of the proposed Home Automation web page

In Figure 5 shows the different screenshots of web page. In 1<sup>st</sup> page we can control all the appliances with single switch, in 2<sup>nd</sup> page lights control, in 3<sup>rd</sup> page fans control, 4<sup>th</sup> camera live stream page with servo rotation control, 5<sup>th</sup> & 6<sup>th</sup> sensor status pages.

## V. CONCLUSION

The home automation using Internet of Things has been experimentally proven to work satisfactorily by connecting simple appliances to it and the appliances were successfully controlled remotely through internet. The designed system not only monitors the sensor data, like temperature, gas, light, motion sensors, but also actuates a process according to the requirement, for example switching on the light when it gets dark. It also stores the sensor parameters in the cloud in a timely manner. This will help the user to analyze the condition of various parameters in the home anytime

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anywhere. The code provided is generic and flexible in a user-friendly manner and can be extended for any future applications like power control, surveillance, etc., easily. Moreover, this technique is better than other home automation methods in several ways.

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